79 Eating for Energy

One important part of every organism's habitat is a source of food. The introduction of new species into an ecosystem often changes the availability of food.

How are the energy relationships among organisms in an ecosystem affected by the introduction of a new species?

MATERIALS

For each student

- **Student Sheet 77.2, "Anticipation Guide: Introduced Species—Zebra Mussels," from Activity 77**
- 1 **Student Sheet 79.1, "Talking Drawing: Eating for Energy"**

READING

Use Student Sheet 79.1, "Talking Drawing: Eating for Energy," to prepare you for the following reading.

Is it possible that a scenario like the one in Lake Victoria could happen in the United States? Scientists are waiting to see. But in the United States, the main concern isn't a large predator like the Nile perch, but a seemingly unimportant mussel less than two inches long. The tiny zebra mussel *(Dreissena polymorpha)* (shown at left) doesn't seem large enough to cause serious problems. But its ability to reproduce and spread quickly is making it into a big issue.

Zebra Mussels feeding.

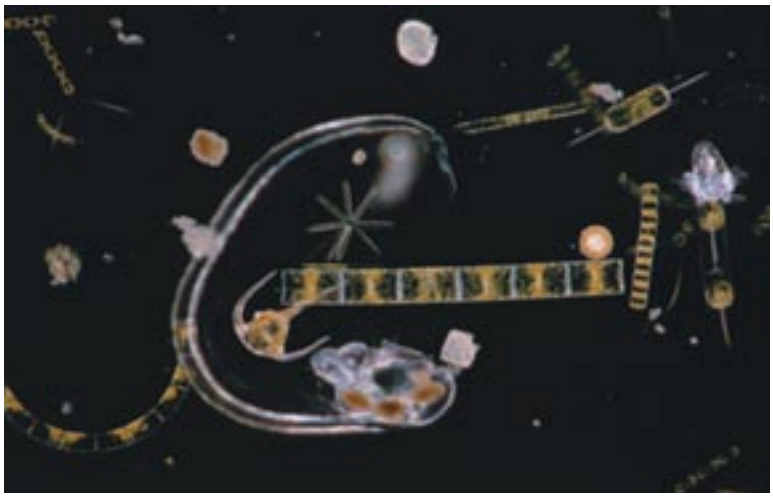
Zebra mussels reproduce by releasing eggs and sperm into the water. The fertilized eggs grow into tiny larvae. Because of their small size, they are very hard to see at this stage.

STOPPING TO THINK 1

Brainstorm ways in which zebra mussels might accidentally be spread from one lake to another.

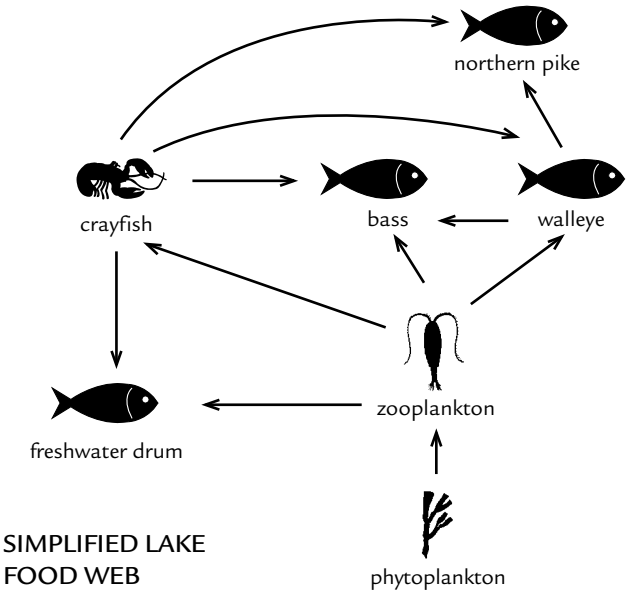
Zebra mussels feed on some of the smallest members of the aquatic food chain: microscopic animals and plants known as **plankton** (PLANK-tun) (shown below). (When discussing them in more detail, biologists usually use the words *zooplankton* [zoe-uh-PLANK-tun] for microscopic animals and *phytoplankton* [fie-toe-PLANK-tun] for microscopic plants.) Plankton are found throughout the water, from the very deepest part of a lake to the surface. They are the food for a variety of other organisms, including many kinds of fish. In addition, zooplankton eat phytoplankton. Thus, phytoplankton are at the base of many aquatic food chains.

Phytoplankton include microscopic plants and algae. These tiny organisms are especially important in aquatic ecosystems because they produce food for all the other living things in that ecosystem. You may know that plants and algae require sunlight in order to grow. They use sunlight as energy to convert carbon dioxide and water into food—a process known as **photosynthesis** (foe-toe-SIN-thuh-sis). (You will learn more about photosynthesis in Activity 81, "A Producer's Source of Energy.") The food that the plant produces is stored within the plant as starch or sugar. The plant can then use its food for activities within its own cells—until the plant is eaten by another organism! Since most plants and algae do not eat other organisms for food but are able to produce their own food, they are called **producers**. Producers such as phytoplankton form the base of the food chain because they have the ability to use the sun's energy to make their own food.



Plankton

All other organisms rely on this ability of producers to convert the energy from the sun into food energy. Organisms that get their energy by eating food are known as **consumers**. Some consumers eat plants for energy, while other consumers eat the animals that eat plants. Some consumers, such as zebra mussels and humans, eat both plants and animals.



SIMPLIFIED LAKE FOOD WEB

STOPPING TO THINK 2

Why are producers, such as plants, an essential part of any ecosystem?

The figure at left shows a simplified lake food web with both producers and consumers. The transfer of energy that takes place when one organism eats another is shown by arrows. Each arrow shows where the energy from the food is going within the ecosystem. The arrows show who is eaten by whom, not who eats whom. Many other species eat phytoplankton; food webs become more complicated when additional relationships are added.

STOPPING TO THINK 3

a. Copy the diagram above into your science notebook. Identify each organism as either a producer or a consumer.

b. Think about the kinds of food that people eat. Use this knowledge to add humans into this lake food web.

c. In the lake food web, humans are consumers. Are humans always consumers? Explain.

After zebra mussels appeared in the Great Lakes ecosystem, they changed the food web. Zebra mussels filter water and catch the microscopic plankton that live in the water. They rely on phytoplankton and zooplankton for food. Because zebra mussels are often more common than other sources of food, crayfish and freshwater drum are starting to eat zebra mussels as part of their diet.

STOPPING TO THINK 4

Using the diagram above as a guide, create a lake food web that includes zebra mussels. Be sure to show how zebra mussels get their energy *and* how other organisms get energy from them.

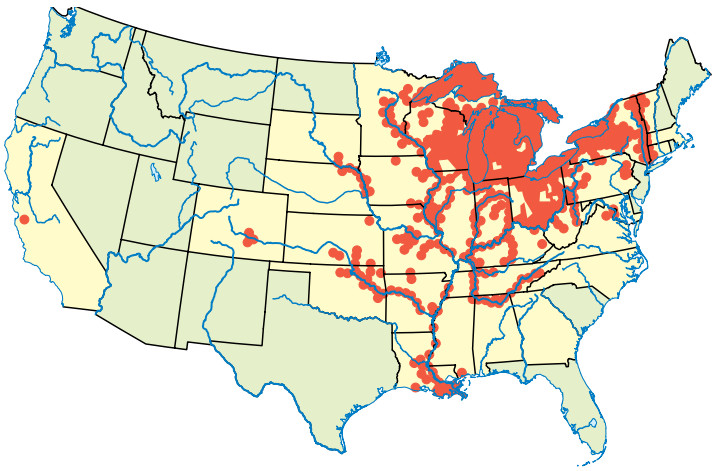
At first, these changes don't seem too important. After all, couldn't the lake ecosystem support one more consumer? Adult zebra mussels filter about one liter of water per day. This means that a two-inch mussel can filter enough water to fill half of a large soft drink bottle every day. In some parts of the Great Lakes, the concentration of zebra mussels has reached as high as 70,000 mussels in a square meter. This means that just a small area of mussels would be able to filter 70,000 liters of lake water each day! As a result of zebra mussels, the clearness of the water has changed: it is now 600% clearer than it was before the introduction of the zebra mussels. Clear water sounds like a good thing, but biologically speaking, extremely clear water can mean that there is not much alive in the water. In fact, the zebra mussel population has been so effective at filtering plankton that the populations of some types of phytoplankton have decreased by 80%.

Remember, phytoplankton are the base of this aquatic food chain. By removing large amounts of phytoplankton from the water, zebra mussels remove the food for microscopic zooplankton. Many types of fish depend on zooplankton for food. In some cases, these fish are the food for other fish and for humans and other mammals. Some ecologists predict that zebra mussels will change the entire food web of the lake ecosystem. However, there is no evidence yet that zebra mussels have affected fish populations in the lake.

There is evidence, though, that the types of plants in the lake are changing. Because of the increased clearness, sunlight is now able to penetrate deeper into the lake. Plants such as algae are now growing along the lake bottom. This provides habitat and food for other organisms, such as sunfish, that are currently not common in the lake. Some scientists predict that the fish populations will change: populations of some fish, like walleye, will decrease, while populations of other fish, like sunfish, will increase.

What will happen to the lake ecosystem? At this point, no one is sure. The one thing that everyone is sure of is that zebra mussels will spread. The dots on the map below mark areas where the zebra mussel is now found.

SPREAD OF ZEBRA MUSSELS ACROSS THE UNITED STATES JUNE 2008



STOPPING TO THINK 5

Look at the Zebra Mussel map, the lines across the U.S. represent large rivers. Where do you predict zebra mussels will be found in the next 10 years? The next 20 years? The next 50 years? Explain your predictions.

ANALYSIS

1. Fill in the "After" column for Statements 3–5 only on Sheet 77.2, "Anticipation Guide: Introduced Species—Zebra Mussels." Did your thinking change?
2. Complete steps 2 and 3 on Student Sheet 79.1, "Talking Drawing: Eating for Energy." Has your thinking changed? Explain.
3. A volcano erupts 40 miles from the lake ecosystem whose food web you drew in Stopping to Think 4. Ash from the eruption blocks sunlight over your ecosystem for several months. Explain what happens to each population within the lake food web in the weeks that follow the eruption.
4. The ash clears and several more months go by. Think about what is now happening to your lake ecosystem. Identify what factors will affect how quickly it recovers.
5. **Reflection:** Think about what you have learned about introduced species as well as ecosystems. What effect(s) can an introduced species have on an ecosystem?

EXTENSION

Go the *Issues and Life Science* page of the SEPUP website to link to the website of the United States Geological Survey. What is the current status of zebra mussel spread across the U.S.?